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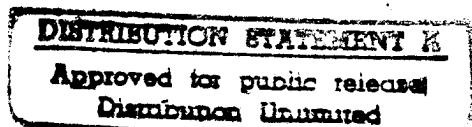
A MODEL FOR NUCLEAR ARMS CONTROL  
IN THE 21ST CENTURY

A Research Paper

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The Directorate of Research

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## **Disclaimer**

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## ***Preface***

The authors wish to acknowledge the personal guidance of Lieutenant Colonel Bradley S. Davis and his commitment to our research group. His insights and comments helped shape the ideas and concepts used to develop the political arms control model. The authors are deeply grateful for his outstanding support and we hope were able to capture his enthusiasm for arms control in the project. Major Frank Gallegos of AF/XOXI at the Pentagon was also a principal supporter of this work. Major Gallegos' suggestions about how to approach the subject of arms control and the orientation he setup and hosted at the Pentagon proved invaluable to this work. We are indebted to him for his efforts.

*Arms Control Research Team  
Air Command and Staff College  
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### ***Abstract***

This paper breaks new ground by developing an innovative arms control model to explain how nations use instruments of national power to achieve their strategic arms control objectives. The model uses the principles of feedback to show the cause and effect relationship between two or more countries with competing arms control objectives. Feedback is a natural process present in almost all dynamic systems involving human behavior. The paper develops a notional political feedback loop where the country to be influenced is defined as a *system*. Another nation then uses its instruments of national power to influence this *system* to achieve the desired arms control outcome.

After an overview of arms control issues in the post-Cold War, the paper transitions into the ideas and concepts used to develop the arms control model. The arms control model described here is fully universal. To present the model, this paper uses the United States and Ukraine as pilot countries. Ukraine is a real-world example where the United States has a vested interest in nuclear arms control. After the United States–Ukraine case study, the authors suggest how nations will employ arms control in the future. Although the focus of this paper is on nuclear arms control, the model is applicable to all weapons of mass destruction. The paper closes with a summary of results and suggests how to use the model for further research.

## **Chapter 1**

### **Background**

*Arms control is an integral part of our national security strategy.*

—1995 National Security Strategy  
of Engagement and Enlargement

### **Introduction and Problem Definition**

Arms control theory and practices matured during the Cold War; however, a major re-evaluation of arms control objectives, processes, and institutions has not kept pace with the transition from the Cold War, bipolar world to the present-day, multipolar world.<sup>1</sup> This transition was inaugurated with the breakup of the Soviet Union which signified the end of the Cold War. This transition has brought new arms control challenges as nations assimilate into the new world order.

The first post–Cold War arms control dilemma came about when the Soviet Union dissolution created four new nuclear nations—Russia, Ukraine, Belarus, and Kazakhstan. The emergence of these new nuclear nations raised unprecedented questions about the political status and legality of the Strategic Arms Reduction Treaty I (START I) signed by the United States and the former Soviet Union on 31 July 1991.<sup>2</sup> Ever since the Soviet dissolution, the United States has worked continually with the four new nuclear nations to adapt the START I treaty into a workable instrument for arms control. Initially, the May

1992 Lisbon Protocol seemed to resolve the START I dilemma by making Russia the sole heir of the Soviet nuclear arsenal. Several factors, which will be addressed later, required the negotiation of the Trilateral Agreement between the United States, Russia, and Ukraine. This agreement seemingly resolved remaining START I issues. Even though this initial post-Cold War arms control dilemma has apparently been resolved, several questions remain about the direction and utility of post-Cold War arms control.

Previous research has examined arms control in the post-Cold War timeframe; however, none have addressed the fundamental framework which underlies arms control objectives, processes, and institutions. The basic arms control framework would help explain how nations operate to achieve their strategic objectives within the context of strategic arms control. The previous omission of an arms control framework has obscured many basic questions surrounding the strategic arms control process. For instance, it is unclear how to derive meaningful arms control measures of effectiveness without an overarching arms control framework. Furthermore, it is also unclear if arms control continues to serve the United States security interests in the emerging world order. Once again, the lack of an arms control framework clouds this issue. Even the fundamental purpose of post-Cold War arms control remains ambiguous without a strategic arms control framework. Hence, there exists a real need to develop the fundamental framework of arms control.

### **Thesis Statement and Scope of Research**

In the present world order, as in the Cold War, nations continually tailor their strategic arms control objectives in a political feedback process which can be modeled

and analyzed.<sup>3</sup> In particular, nations interact through a continual feedback process of assessment, strategy formulation, and policy implementation to attain their strategic arms control objectives with other nations. While engaged in this strategic feedback process, nations enter into arms control negotiations to seek agreements which formally consolidate the attainment of their strategic arms control objectives.<sup>4</sup> Uncertainty affects fundamental aspects of this feedback process through fog and friction.

The thesis statement above presupposes that nuclear arms control serves the same purpose today as it did during the Cold War.<sup>5</sup> Clearly, the actors have changed since the end of the Cold War—the demise of the Soviet Union created four new nuclear nations in addition to other emerging nuclear nations in other regions of the world.<sup>6</sup> Although new nations have entered the strategic arms arena, strategic arms control continues to serve the same fundamental purpose it has always served, namely as a means of nuclear threat reduction and strategic influence. During the Cold War, nuclear arms control served as a means for the two superpowers to reduce the threat of nuclear confrontation as well as influence other nations for strategic purposes.<sup>7</sup> Today, nuclear arms control continues to serve as a means of achieving strategic security and influence. The continuity of purpose in arms control today will become evident from the political arms control model developed in this research.

Arms control negotiations encompass a forum for diplomatic war, in other words, “diplomacy by other means.” Indeed, the mixed arms control objectives of the opposing nations often drive negotiations. A general understanding of the arms control process between nations is key to understanding how negotiations originate. This work details how nations interact in a dynamic give-and-take process whereby nations seek to realize

objectives using existing instruments of power while simultaneously developing new instruments of power to achieve their objectives. Concurrently, nations enter negotiations to formally achieve their arms control objectives.

This work also provides an ordered perspective of the arms control process as a model which reflects how nations exert influence using a variety of means (i.e., instruments of power) to achieve their arms control objectives. Without a structured framework, arms control mechanisms are manufactured ad hoc to cater to specific situations. This report offers a more structured perspective in which the arms control process can be clearly framed and, therefore, better understood and controlled. To this end, the fundamental arms control framework is developed in order to examine how specific objectives evolve over time. Nations not only seek to influence others, but they are also influenced by others. Moreover, nations can alter their objectives in the course of events. Hence, arms control objectives require clear measures of effectiveness for arms control.

The measures of effectiveness applied to arms control should convey the degree to which the arms control objectives are met. If all parties agree to control their arms, this agreement meets their political objectives, and if all parties abide by the agreement, then arms control is deemed “effective” by all parties. Conversely, if one or more parties enter into an arms agreement which does not meet their objectives (say, due to coercion) or which they intend to defy (say, due to a hidden agenda), then arms control is “ineffective” from one or more of the party’s viewpoints. Hence, effective arms control must not only fulfill the objectives, it must be measurable and verifiable as well.

Arms control effectiveness can be determined directly from the political arms control model proposed in this work. Moreover, the direct measurement of objective fulfillment is central to the arms control model. The model also suggests what to measure although the specific measurement techniques and aspects must necessarily depend on the particular arms control objectives.

A final question this work seeks to answer deals with whether or not arms control serves United States security interests in the current world order. As United States objectives vary in response to the changing world order, its policies are inherently aimed towards promoting regional stability. In other words, the United States seeks predictable, peaceful transitions of national governments which do not threaten regional security. In order to enhance security, the United States must seek to fashion arms control objectives for regional stability in the new world order. The political arms control model developed in this work strongly suggests a tailored approach toward regional arms control.

Capability-based arms control is at the center of achieving this balance of security and expense—the arms control model presented here provides insight to attain this balance. Arms control serves United States security interests by encouraging force structuring based on threat assessments of other nations. Proactive, capability-based arms control gives the United States the best opportunity to field a force sufficient to achieve its national security objectives, and at the same time, compete effectively as a strong economic power in the global market.

## **Overview of This Work**

Chapter 2 develops the political arms control model based on the principles of feedback control. Chapter 3 illuminates the political arms control model with a study of arms control between the United States and Ukraine. In addition, Chapter 3 applies the political arms control model to interactions and negotiated arms control agreements between these two nations. The paper concludes in Chapter 4 by summarizing this research and recommending how it can be carried forward.

## **Notes**

<sup>1</sup> Henry Kissinger, *Diplomacy*, (New York: Simon and Schuster, 1994), chapters 1 and 31.

<sup>2</sup> It was unclear how to carry forward the treaty obligations of the former Soviet Union since this was without precedent.

<sup>3</sup> It is understood that critics such as Graham Allison might dismiss any attempt to model inter-governmental dynamics by labeling it a monolithic “Rational Actor Model” (see Graham T. Allison, *Essence of Decision* (Boston: Harper Collins Publishers, 1971)). Allison puts forth alternative organizational and bureaucratic models which seek to explain government’s non-unitary decision making and action taking processes. The main omission of his work is the lack of an overarching relationship between the strategic (monolithic) model with his tactical and operational (organizational and bureaucratic) models. The strategic model developed in this work accommodates this relationship; however, the focus remains at the strategic level while dropping to the tactical and operational levels as required.

<sup>4</sup> In general, arms control agreements result from arms control negotiations.

<sup>5</sup> The focus of this paper is on nuclear arms control; however, the discussion applies equally to the control of all weapons of mass destruction.

<sup>6</sup> North Korea and Pakistan are recent examples emerging nuclear nations.

<sup>7</sup> Robert L. Pfaltzgraff, Jr., “The American-Soviet Relationship in Global Perspective,” in *American Defense Policy*, (Baltimore, Md.: The Johns Hopkins University Press, 1980), 5.

## **Chapter 2**

### **A Model of the Bilateral Arms Control Process**

*Know the enemy, know yourself.*

—Sun Tzu

#### **Introduction**

This chapter develops a framework to analyze arms control as a structured, yet dynamic process. This framework is defined through a model which reflects the arms control process undertaken by nations that set out to influence opposing nations. The environment in which arms control agreements are forged is highly volatile where numerous actors and conditions influence the final product. Although the tools developed in this chapter draw heavily on systems theory, the authors acknowledge that arms control is a human enterprise and that wiring diagrams and flow charts accomplish nothing by themselves. People run governmental processes, and people are not always logical, reasonable, or unbiased.<sup>1</sup> The framework developed here attempts to capture the human dynamics of arms control and, at the same time, give the process structure. In order to better understand the political arms control model, key concepts of feedback control are discussed first.

## **Feedback Control Overview**

Feedback control is a process tool typically employed by engineers to control physical systems. Similar feedback concepts can offer significant insights into how internal and external forces shape inter-governmental dynamics. This section uses the principles of feedback control to explain the arms control process. The next few paragraphs introduce definitions and concepts used later to develop the political arms control model. A few examples of feedback systems will help introduce key ideas and concepts of feedback control.

Although feedback control is a formal field of engineering, most readers are already quite familiar with the concepts of how a feedback system works. Simple examples of feedback systems include heaters, air conditioners, cruise controls, anti-lock brakes, and auto pilots. An air conditioner is perhaps the most familiar example. A thermometer placed on the wall senses the temperature in a room and feeds this information (feedback) to a thermostat. The thermostat acts as a controller which compares the measured room temperature to the desired room temperature set by the occupant. If the measured room temperature differs from the desired room temperature, the thermostat (controller) sends the air conditioner (system) a signal to either turn on, turn off, or maintain the same status. This feedback process continues until the occupant turns off the air conditioner.

A human is an example of a very robust feedback system. For example, take something as simple as using a hand to grasp an object. The desired hand position is the position that will allow the person to grasp the object. The eyes (sensor) measure the actual position of the hand and then feed this information to the brain (controller) which compares the actual to the desired hand position. If the difference between the two is not

acceptably small, the brain (controller) sends a message to the muscle cells (actuator) to move the hand (subsystem) towards the object. This feedback process continues until the hand is close enough to grasp the object.<sup>2</sup> Keeping these examples in mind will help the reader understand how the authors apply the concepts of feedback to arms control. Table 2-1 lists a few more examples of feedback control systems.

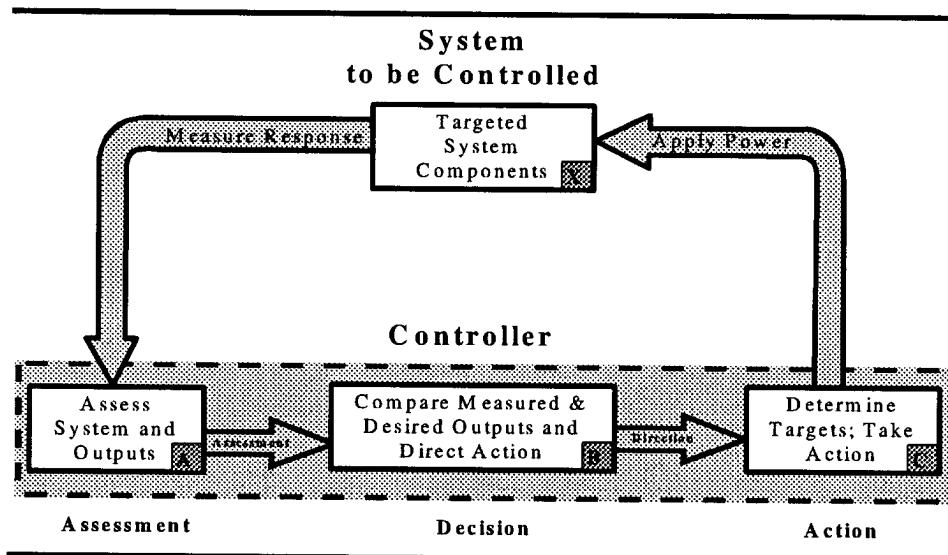
**Table 2-1. Examples of Feedback Control Systems.**

EXAMPLE	CONTROLLER			SYSTEM
	SENSOR (Assessment)	COMPUTER (Decision)	ACTUATOR (Action)	
Climate Control	Thermometer	Thermostat	Electrical Signal	Heater / air conditioner
Cruise Control	Speedometer	Cruise Control	Accelerator	Engine/ transmission
Auto Pilot	Gyrosopes	Auto Pilot	Ailerons	Wings
Arms Control	Intelligence/ Inspections/ Reconnaissance	Political Leadership	Instruments of Power	Opposing Country

## Feedback Control Principles

Discussing the concepts of feedback control as a step-by-step process makes it easy to follow the logic of Figure 2-1. Feedback control is based on an assessment-decision-action cycle which repeats continuously as shown in Figure 2-1. The diagram illustrates two main components: a controller and a system to be controlled. The controller is responsible for keeping the system outputs within specified limits. To do so, the controller generates commands to make the measured system response converge to the desired response. In Figure 2-1 the controller is separated into three functional parts labeled “A,” “B,” and “C” and the system it controls as “X.” The feedback cycle begins

with a measurement of the system response which is “fed back” to the controller in “A.” The controller uses this feedback measurement to assess the state of the system which it forwards to the decision block. In “B,” the controller compares the assessment with the desired system state and, if action is necessary, the controller passes directions to “C.” Subsequently, the controller targets specific components of the system in an attempt to achieve the desired system state. Finally, the controller applies power to the targeted system components of “X” and then measures the effect to provide feedback for the assessment in “A.” The controller repeats this feedback cycle continuously in an effort to equalize the measured and desired system outputs; this process produces the desired system state because it corrects the measured error.<sup>3</sup> This assessment-decision-action cycle description will prove useful to understand the arms control analysis which follows.



**Figure 2-1. Feedback Model Demonstrates the Assessment-Decision-Action Cycle<sup>4</sup>**

In order for the controller in Figure 2-1 to equalize the measured and desired outputs, the system it wishes to control must satisfy two constraints. First, the system must be controllable in order for applied power to influence the system outputs in a tangible way.

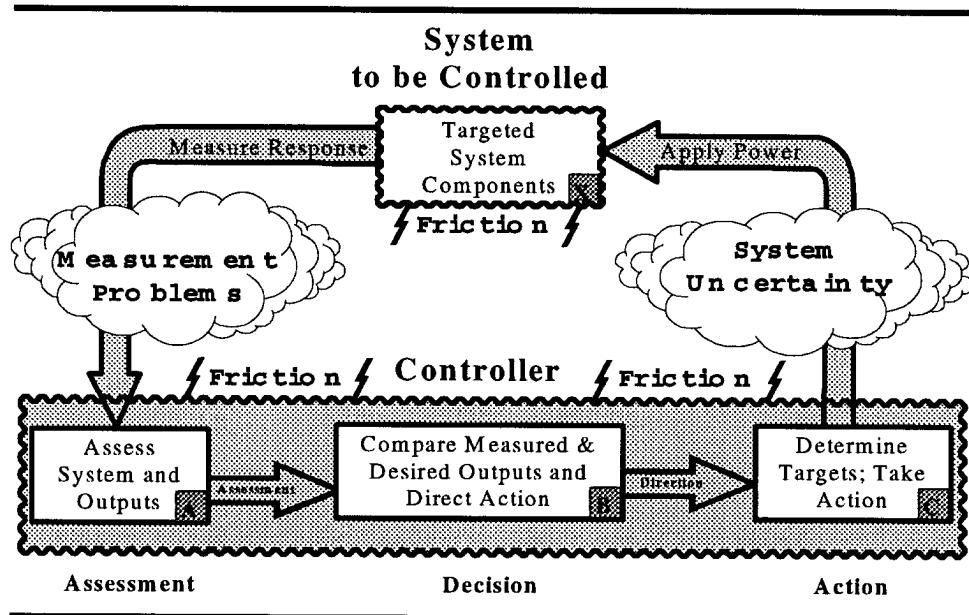
Second, the system outputs must be measurable in order to provide feedback for the controller to assess and compare the measured and desired system outputs. In addition to these system constraints, the controller needs to satisfy three conditions. The controller must be able to: (1) assess the system outputs, (2) determine actions to affect the system outputs, and (3) apply power to influence the system to produce the desired outputs. Thus, a successful feedback control model requires a system that is measurable and controllable with a controller capable of assessing, deciding, and influencing the system to achieve the desired response.<sup>5</sup>

## **Feedback Stability**

The main goal of feedback control is to minimize the difference between the desired and actual system outputs; this goal is tied to the concept of stability.<sup>6</sup> For a properly designed feedback system, the controller applies power to stabilize the system by attempting to bring about the convergence of the measured and desired outputs. For this paper, stability is achieved when the difference between the measured and desired system outputs become acceptably small. From this definition, stability is clearly tied to interpretations of “desired” outputs as well as what the “acceptable” difference is; hence, stability depends on the particular perspective of the actors involved in the system. The implication for strategic arms control is that stability is actor (i.e., nation) dependent. For example, stability between the United States and other nations depends not only on the United States’ specific strategic arms control desires, but also upon how much latitude the United States will tolerate in its strategic arms control desires. Hence, each actor must qualify what is desired and then what constitutes acceptability from its perspective.

## **Fog and Friction in Feedback Control**

In seeking to apply feedback control principles to better understand the arms control process, an account must be given of the inevitable fog and friction which affect any real world political process. Figure 2-2 shows how system uncertainty and measurement problems obscure the targeting and assessment processes, respectively. System uncertainty (i.e., the lack of accurate, complete knowledge of the system to be controlled) can cause the applied power to miss the targeted system components and introduce a controllability problem. For example, when targeting the political will of the opposing nation, uncertainty about the likely response can produce undesired results. Likewise, problems in measuring the system, such as gaining access to particular outputs, are a form of fog which prevents the controller from measuring the true state of the system. This results in a measurability problem which influences the controller's ability to assess the system. Furthermore, an inaccurate assessment can cause a domino effect throughout the rest of the controller. For instance, the inability to reconnoiter an opponent's nuclear capability is a source of fog; the resulting assessment could assume too great an opponent capability resulting in an unnecessary decision to increase the force structure. Thus, fog can induce a cascading effect. Both system uncertainty and measurement problems intervene between the controller and system as depicted by the fog of Figure 2-2.



**Figure 2-2. The Feedback Control Model With Fog And Friction**

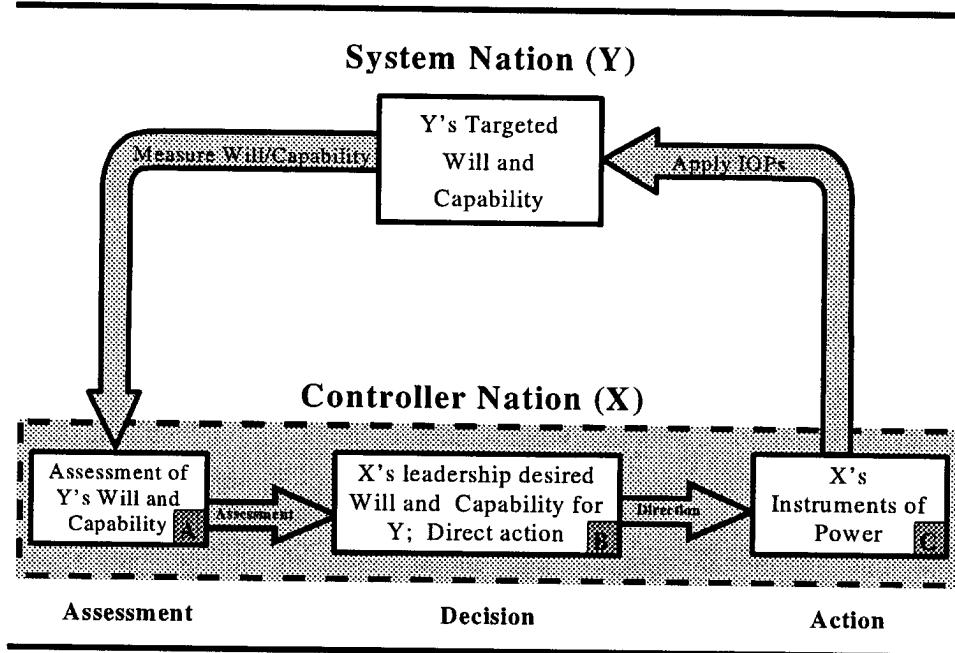
In comparison to fog, which affects the interaction between the controller and system, friction resides within both the controller and system. In the engineering realm, friction consists of the hardware and software limitations of the controller and system. Controller friction consists of factors which impede the controller's assessment, decision, or action steps. Similarly, system friction resides within the targeted system and impedes its operation. An example of friction in the political realm is conflicting efforts resulting from poor communications among the various instruments of power. Another example of friction includes competing decision makers (e.g., the President versus Congress) which can obstruct operations in either the controller or system nations.

Fog often exacerbates and contributes to friction. For instance, system measurement fog contributes to inaccurate and incomplete assessments. In turn, these flawed assessments can cause negative cascading effects. For example, a nuclear reactor controller which bases decisions on flawed temperature measurements can produce an

uncontained nuclear meltdown. In addition to system measurement fog, system uncertainty fog can cause the misapplication of power to the system. A simple example is also found in the case of the nuclear reactor controller. If the fuel rod actuators are incorrectly wired due to the electrician's uncertainty of the proper configuration, the system may undergo a meltdown even though measurement data is correct. Hence, fog can sometimes induce friction in the system resulting in complete instability. This discussion of fog and friction in feedback systems completes the essential background of feedback control. The next step is to develop a political arms control model based on feedback principles.

## **The Unilateral Arms Control Model**

This section introduces a political arms control model which depicts how nations act unilaterally to achieve their strategic objectives. Generally, it is true that nations seek to influence or control the action or behavior of other nations. Therefore, one can view a nation as a controller which attempts to exert influence on an opponent nation to achieve its objectives, while at the same time monitoring how well those objectives are being met. In the most basic instance, a nation may unilaterally exert influence on another nation as depicted in the unilateral arms control model in Figure 2-3. The influence is aimed at changing the opposing nation's will and capability; this will be discussed in the next section.



**Figure 2-3. The Unilateral Arms Control Model**

A comparison of Figure 2-1 with Figure 2-3 illustrates the proposed feedback nature of the political arms control model. The country seeking to exert unilateral influence is labeled “X” and the targeted country as “Y.” Momentarily assuming no fog or friction, the feedback cycle begins in block “A” with X measuring and assessing Y’s will and capability through various means of intelligence, reconnaissance, and surveillance. Note that measurement and assessment are continuous processes which produce constant updates concurrent with subsequent steps. After receiving the assessment, X’s leadership (i.e., the President, Cabinet, and Congress) collectively decides whether key aspects of Y’s will and capability meet their desires. Accordingly, the leadership directs action through its instruments of power (i.e., political, military, economic, and information) to effect change or maintain the status quo in Y. Upon application of the instruments of power, the effects are measured and fed back to update the assessment of Y. Assuming X has sufficient instruments of power to affect Y, and Y is controllable with key,

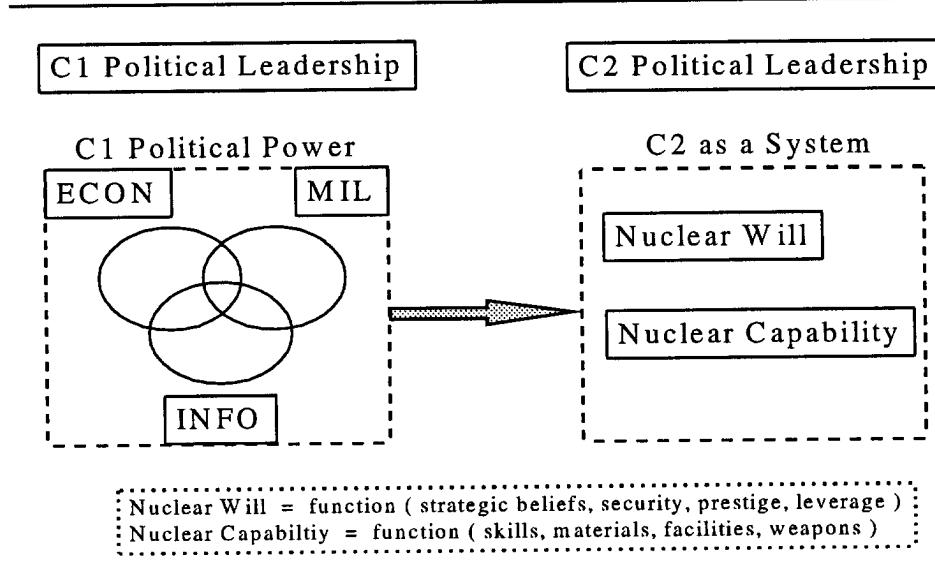
measurable aspects of nuclear will and capability, the feedback cycle repeats until X achieves its desires. Israel's action against Iraq at Osirak offers an example of unilateral arms control. First, Israeli intelligence assessed the Iraqi nuclear weapons program and forwarded this information to Israel's leadership. Subsequently, Israel's leadership judged the Iraqi program to be undesirable and unacceptable. Hence, Israel acted unilaterally through its military instrument of power to destroy the Iraqi reactors at Osirak.

Remarkably, the assessment-decision-action cycle follows Sun Tzu's dictum "know the enemy, know yourself." In particular, the feedback cycle's assessment step seeks to fulfill "know the enemy" by gathering intelligence to understand the counterpart's motivations, capabilities, and likely responses. The decision-action steps seeks to complete "know yourself" by understanding one's own national will and capabilities. Successful governments formulate attainable desires based on their assessment of the opposing nation as well as knowledge of their own characteristics and objectives. Thus, Sun Tzu's guidance clearly exists within the political feedback process.

## **Nuclear Will and Capability**

A core concept of the political arms control model employs the instruments of power to target the nuclear will and capability of an opponent country.<sup>7</sup> Numerous factors come together to shape the national will of a country including history, religion, culture, social, and regional makeup. Although national will resides throughout the population, it is the political leader's will which the instruments of power must ultimately influence. The political leadership not only controls the nation's nuclear arsenal but can negotiate

agreements as well.<sup>8</sup> However, when applying the instruments of power to influence a country, the unofficial leadership is often a significant source of friction vulnerable to influence for cascading effects.<sup>9</sup>



**Figure 2-4. Instruments of Power Directed at Nuclear Will and Capability<sup>10</sup>**

The targeted country is viewed as a system composed of nuclear will and capability as shown in Figure 2-4. National nuclear will is a multifaceted function of strategic influence, regional security, international prestige, and bargaining leverage. In addition, national nuclear capability is a function of engineering skills, fissile materials, nuclear facilities, and actual weapons.<sup>11</sup> Nuclear will and capability are closely coupled. For instance, Iraq and Japan offer examples at opposite ends of the will/capability spectrum. In the case of Iraq, there is a strong Iraqi will to obtain nuclear weapons; however, its capability remains limited. At the other end of the nuclear spectrum, Japan clearly possesses the capability to produce nuclear weapons, however, its nuclear pacifism combined with the United States' security umbrella precludes its strategic armament.<sup>12</sup> By analyzing the target country as a system composed of nuclear will and capability, the

controller nation can begin to deploy its instruments of power to achieve its arms control objectives.

## **Instruments of Power**

Nations use instruments of national power to interact with one another within the arms control process. This paper defines instruments of power as the political, military, economic, and information means a nation can bring to bear on an opposing nation to alter its will and capability.<sup>13</sup> The physical sciences define power as the ability to do work; this definition equally applies to the various instrument of national power. For instance, the military instrument of power connotes an ability to do military work such as conduct war. Instruments of power are tools a nation uses to influence an opposing country or affect events that lead to a country changing its position or behavior. Table 2-2 lists significant instruments of national power.

**Table 2-2. Some United States Instruments of Power<sup>14</sup>**

INSTRUMENTS OF POWER FOR ARMS CONTROL			
DIPLOMATIC	MILITARY	ECONOMIC	INFORMATION
<ul style="list-style-type: none"> <li>• Develop special teams</li> <li>• Identify steps to peaceful resolution</li> <li>• Alter existing meetings or schedules</li> <li>• Identify official or unofficial national leaders who may be able to solve the problem</li> <li>• Strengthen international rapport</li> <li>• Use the United Nations or other international organizations</li> <li>• Show international resolve</li> <li>• Gain popular support</li> <li>• Increase/reduce international diplomatic ties</li> <li>• Restrict activities of diplomats</li> <li>• Reduce embassy personnel</li> <li>• Increase cultural group pressure</li> <li>• Use non-governmental agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Strategic reconnaissance</li> <li>• Intelligence collection</li> <li>• Show of force</li> <li>• Electronic measures</li> <li>• Exercises</li> <li>• Joint/coalition operations</li> <li>• Staff visits</li> <li>• Cooperative programs</li> <li>• Share technology</li> <li>• Exchange programs</li> <li>• Security assistance</li> </ul>	<ul style="list-style-type: none"> <li>• Restrict transactions</li> <li>• Embargo goods &amp; services</li> <li>• Start/cancel programs</li> <li>• Enact trade sanctions</li> <li>• Financial assistance</li> </ul>	<p>Increase information directed at:</p> <ul style="list-style-type: none"> <li>• International audience</li> <li>• People in the nation</li> <li>• Allies of opponent</li> <li>• Friendly coalitions</li> <li>• Leadership</li> <li>• Military</li> <li>• Business community</li> <li>• Financial institutions</li> <li>• Corporate transactions</li> <li>• Keep issues as lead story</li> <li>• Summits &amp; meetings</li> <li>• State &amp; official visits</li> </ul>

## **Fog and Friction Unique to the Political Feedback Process**

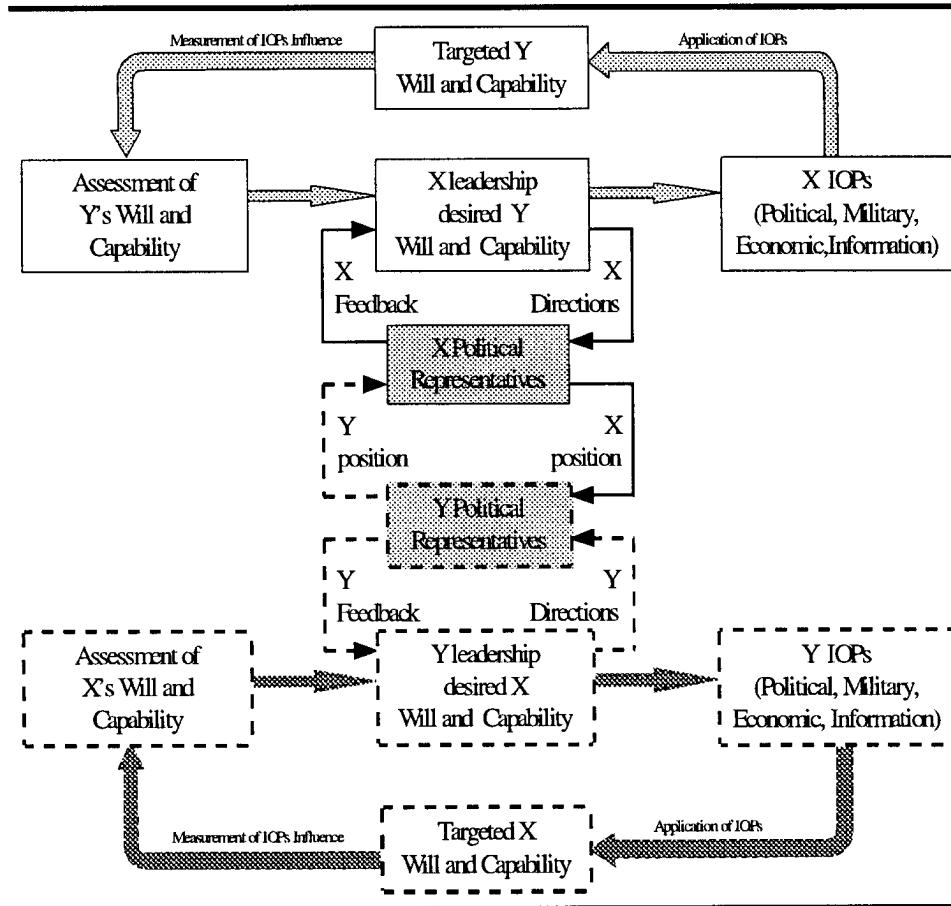
Inevitably, fog and friction enter the political feedback process through uncertainty about the targeted nation as well as through measurement problems of key aspects of that nation. In addition, fog and friction can affect the arms control process through the time-varying nature of governments. Over time, national governments undergo changes ranging from minor variations to dramatic transformations. For example, the dissolution of the Soviet Union in 1991 left the United States and the multitude of post-Soviet Union governments in a temporary quandary about how to apply previously agreed-to arms control treaties. From the United States perspective, the breakup of the Soviet Union created fog which engulfed the previously structured arms control process. However, from the Soviet Union's perspective, internal friction brought about its very disintegration. Hence, the time-varying nature of fog and friction affects interaction between governments.

To some degree, friction affects governments as they seek to influence other nations to achieve their arms control objectives. In other words, as nations try to achieve their arms control objectives, they induce some degree of self-friction. Returning to the Cold War example above, both the Soviet Union and the United States spent vast treasures on the strategic arms race while trying to achieve their strategic objectives. The very act of increasing strategic arms depleted economies and was a source of much friction, particularly in the Soviet Union. Hence, actions aimed at arms control produce friction as a natural byproduct.

## The Bilateral Arms Control Model

The cumulative efforts of the previous sections allow the introduction of the most important model of this work, namely the Bilateral Arms Control Model. The significance of this model is its ability to explain the arms control process between two nations or two groups of nations.<sup>15</sup> In the model, two nations or groups of nations seek to influence one another through their own feedback cycles while simultaneously participating in arms control negotiations.

The Bilateral Arms Control Model depicted in Figure 2-5 illustrates how two nations, labeled X and Y, simultaneously engage in their own feedback cycles to influence one another. In this figure, the assessment-decision-action cycle of X is depicted in the top portion of the diagram with solid lines while the feedback cycle of Y is depicted in the lower portion with dashed lines. Concurrent with these feedback cycles, both nations engage in negotiations. The negotiation model is the diplomatic channel linking the two nations highlighted by the gray background in Figure 2-5.



**Figure 2-5. The Bilateral Arms Control Model**

Before acting to influence another country, a nation generally assesses the other country's will and capability. Subsequently, the national leaders compare the assessed will and capability to what is desired in the opposing country. If there is a difference between the assessed and desired will and capability, the national leaders may direct action be taken through selected instruments of power (i.e., political, military, economic, and information). Each nation applies chosen instruments of power to targeted aspects of the opposing country in an attempt to achieve its objectives. New assessments are then made and the assessment-decision-action cycle repeats. Concurrent with these feedback cycles, both nations engage in diplomatic negotiations as shown in the negotiation process model.

The model captures the essential dynamics of the interactions between two nations. First, note that the feedback cycles between the nations inherently operate at differing rates. In particular, each nation's feedback cycle is a function of each nation's will and capabilities. For example, the nation with the greater will and capability to assess, decide, and act quickly operates its feedback cycle at a faster pace. Second, note that negotiations may take place out of phase with the feedback cycles. Moreover, there is no requirement for negotiations to take place at all. Negotiations usually originate only after one nation assesses the motivations of the opposing nation in order to entice that nation to the bargaining table. The topic of arms control negotiations is so vital to arms control, it is worthy of further discussion.

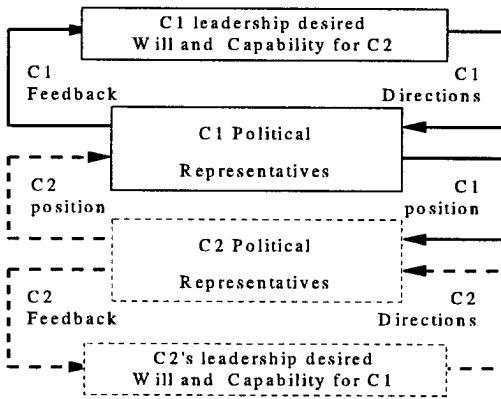
## **Arms Control Negotiations**

Negotiations are fundamental to arms control agreements because they represent the bulk of diplomatic efforts aimed at the fulfillment of arms control objectives. Moreover, arms control agreements generally serve to reduce the fog and friction associated with arms control. For instance, arms control agreements which permit on-site inspections reduce the fog of measurement uncertainty by direct verification. This section does not attempt to discuss the hundreds of tactics and strategies available for negotiators; rather, it addresses the role of negotiations in arms control. Numerous sources are available to the reader who wishes a more detailed treatment of the subject.<sup>16</sup>

This paper defines negotiation as an exchange of information, signals, messages, and arguments between two countries where each attempts to influence the other to agree to act jointly rather than unilaterally.<sup>17</sup> In general, the negotiation forum can vary from

informal to very formal. For example, a rug merchant has complete freedom to set the price of his merchandise whereas a lawyer negotiating with a judge must follow acceptable rules and courtroom decorum. Arms control negotiations fall somewhere between the two examples—freedom to reach agreement within the unwritten, yet formal, rules of international diplomacy.

The arms control negotiation model can be separated from the Bilateral Arms Control Model as depicted in Figure 2-6. Although political leaders are the official negotiators for a country, they traditionally delegate this responsibility to their representatives. The political representatives state their government's official position on an issue and then relay the opposing nation's counter position back to their political leaders. This give-and-take process continues until both nations believe they have met their respective objectives to the best of their ability. When negotiations break down, either one or both nations must modify its position on an issue hoping the concession will lead to more constructive dialogue. Figure 2-6 emphasizes negotiation as a continuous process which plays a decisive role in achieving arms control agreements.



**Figure 2-6. A Model of the Negotiation Process**

Arms control negotiations can break down for many reasons. Negotiations can deadlock if neither side is willing to budge when objectives continue to go unfulfilled; in this instance, one or both countries may choose to act unilaterally outside negotiations. One way to view this problem is to divide the differences between the two countries as conflicts of values or conflicts of interests. Christopher Dupont and Guy-Olivier Faure state:

A conflict of values is a situation in which the parties hold different or incompatible values, ideologies, and principles and in which each party tries to make its own prevail. A conflict of interest corresponds to a discrepancy between the parties preferences concerning the distribution of a scarce resource. A third and common situation is a mix of both conflicts in a complex interplay.<sup>18</sup>

Alternatively, nations can employ their instruments of power, such as economic punishments or rewards, to bring the opposing nation back to the negotiating table. Of course, both nations continue to operate within their respective feedback cycles outside the negotiation process.

During negotiations, nations can exploit the information instrument of power (i.e., through the media) to influence an opponent nation to change its position or behavior. After an agreement to control certain aspects of strategic arms, one nation may choose to exploit loopholes and negate the effectiveness of a previous agreement. North Korea provides an immediate example. North Korea signed the Treaty on the Non-Proliferation of Nuclear Weapons, but stalled and used deception when called upon by the international community to act within the spirit of the treaty. This is an example of how the United States employed information (i.e., the international media) within the United Nations forum to try to influence North Korea for arms control purposes.

A number of technical experts support the political leaders as they attempt to find common ground on issues that are highly technical, political, or both. The experts contribute with their knowledge of foreign affairs, military programs, operational plans, security operations, and national strategy. In the United States, these experts have become essentially institutionalized with significant influence over arms agreements. For example, the Arms Control and Disarmament Agency is the primary institution which coordinates experts in negotiations. The aim of negotiations is an arms control agreement with effective measures for arms control.

## **Measures of Effectiveness**

In arms control negotiations, one nation generally seeks to influence another nation's nuclear will in order to control and subsequently measure aspects of nuclear capability. As discussed earlier, nuclear will is a multifaceted function of strategic influence, regional security, international prestige, and bargaining leverage. In contrast to nuclear

will, which is relatively difficult to measure because of measurement fog, nuclear capability is much more directly measurable. Recall that nuclear capability is a technical function of engineering skills, fissile materials, nuclear facilities, and actual weapons.

Arms control agreements are the capstones of negotiated objectives; the degree of objective fulfillment is reflected by measures of effectiveness. In the context of the Bilateral Arms Control Model, effective measures are those which reduce measurement fog by indicating how well objectives are met. Past measures of arms control compliance have been historically lacking and are only partially resolved by national technical means of verification.<sup>19</sup> Since fog affects the measurement process, effective measures must pierce the fog through redundant means. Indeed, a robust assessment uses intelligence gathered from as many sources as practicable including national technical means, on-site inspections, and human intelligence.

Arms control measures generally emphasize nuclear technological capabilities in order to minimize the effects of measurement fog; however, this approach engenders a danger in focusing too narrowly on accessible measures of arms control. In particular, accessible measures may not accurately reflect objective fulfillment. The Bilateral Arms Control Model suggests that effective arms control measures assess both nuclear will and nuclear capability. Thus, robust measures of effectiveness seek to monitor nuclear will through various means such as diplomatic interactions. For example, North Korea's reluctance to permit United Nation's nuclear inspectors conveyed a distinct hostile nuclear will in addition to a likely nuclear capability. Robust measures of effectiveness continue to monitor of an opponent's will for its own security.

## **Implications for United States Security**

To enhance its security, the United States continually assesses opposing nations' strategic will and capabilities in order to anticipate future threats on the horizon. In the context of the Bilateral Arms Control Model, the continual feedback cycle points to a forward-looking assessment in order to become aware of strategic arms threats. Such an assessment addresses both current threats and anticipated threats resulting from future adversary capabilities. The predominant future arms control threats relate to the proliferation of nuclear capabilities to nations or groups with a hostile nuclear will. In response, the United States takes a leading role in arms control to influence other nations to stem the proliferation of nuclear weapons particularly though the NPT.<sup>20</sup> The United States' actions serve its security interests by acting now to reduce anticipated future threats. An example of this is given in the following chapter.

## **Summary**

This chapter used the principles of feedback to develop a Bilateral Arms Control Model. The model was built on key feedback concepts such as measurability, controllability, and the assessment-decision-action cycle. Furthermore, the model illuminated how fog and friction affect the arms control process. It also provided an ordered perspective useful for examining the arms control process, and gave a structured frame of reference (i.e., the big picture) from which to conduct arms control. The next chapter uses this model to analyze key events in United States–Ukrainian arms control.

## Notes

<sup>1</sup> Frederick H. Hartman and Robert L. Wendzel, *America's Foreign Policy in a Changing World*, (New York: Harper Collins, 1994), 171–173.

<sup>2</sup> John W. Brewer, *Control Systems: Analysis, Design, and Simulation*, (New Jersey: Prentice Hall, Inc., 1974), 1.

<sup>3</sup> This assumes the system is measurable and controllable. These concepts will be explained in the next paragraph.

<sup>4</sup> Even though no line explicitly conveys communication lines within the controller, these are assumed to exist implicitly between each controller block (c.f. Figure 4-2). For instance, the controller decision block tacitly communicates with the assessment operation requesting data on certain measurements. Similarly, the controller action block can receive information directly from the assessment block to assist in developing targeting strategy. Finally, the actor block can request confirmation from the decision block prior to executing an operation. These are not discussed further to maintain the focus on arms control as an explicit, external means of influencing another nation.

<sup>5</sup> It is understood that feedback in physical systems is idealized when compared to feedback in human endeavors such as arms control. In particular, the measurability and controllability of human systems remains somewhat shrouded in fog and friction. The subsequent discussion will address these issues.

<sup>6</sup> John Jaworsky. "Ukraine: Stability and Instability." McNair Paper 42, (Washington, D.C.: Institute for National Strategic Studies, August 1995), 1–5. Many authors, as demonstrated by this reference, have had great difficulty defining stability. The feedback principles examined here allow a clear, workable definition of stability.

<sup>7</sup> This usage of the term "target" conveys the idea that nations seek to influence specific aspects of the opponent nation's will and capability.

<sup>8</sup> If nuclear weapons are in the hands of ultra-national groups (i.e., terrorists), arms control does not matter unless it is a way of preventing these groups from obtaining nuclear arms in the first place.

<sup>9</sup> *Strategic Structures AY96 Bluebook*, Vol. II, "Influencing Leadership," ACSC Research Group, (Maxwell AFB, AL: Air Command and Staff College), 531–542.

<sup>10</sup> Peter R. Lavoy, "Nuclear Myths and the Causes of Nuclear Proliferation." In *The Proliferation Puzzle: Why Nuclear Weapons Spread and What Results*, Zachary S. Davis and Benjamin Frankel, eds., (San Francisco, Cal.: Jossey-Bass Inc., Publishers, 1991), 192–212.

<sup>11</sup> The potential clearly exists for nations or groups to purchase or otherwise procure nuclear weapons thereby inferring nuclear capability.

<sup>12</sup> It is understood that Japan may be re-thinking their nuclear stance given the likely existence of a growing North Korean nuclear arsenal.

<sup>13</sup> Daniel S. Papp, *Contemporary International Relations, Fourth Edition*, (New York: Macmillan College Publishing Company, Inc., 1994), Part Four.

## Notes

<sup>14</sup> Joint Publication 1, *The Joint Staff Officer's Guide*, (Washington, DC: U.S. Government Printing Office, 1993): 6-14 to 6-16.

<sup>15</sup> The Bilateral Arms Control Model developed in this work also addresses multilateral arms control agreements. The view is taken here that multilateral arms control agreements are made "bilaterally." For example, the many signatories to the multilateral NPT fall into two groups: nuclear powers and non-nuclear powers.

<sup>16</sup> See Roger Fisher, William Ury, and Bruce Patton, *Getting to YES*, (New York: Penguin Group, 1991); Chester L. Karrass, *The Negotiating Game*, (New York: Harper Collins Publishers, Inc., 1992); or Chester L. Karrass, *Give and Take*, (New York: Harper Collins Publishers, Inc., 1993).

<sup>17</sup> Christopher Dupont and Guy-Olivier Faure. "The Negotiation Process." In Kremenyuk, Victor A., ed. *International Negotiation: Analysis, Approaches and Issues*. San Francisco, Cal.: Jossey-Bass Inc., Publishers, 1991), 41.

<sup>18</sup> Dupont et. al., 50.

<sup>19</sup> Papp, 468–470.

<sup>20</sup> The United States along with Russia and Great Britain are the lead nations which hold the official instruments of the 172 signatories of the Nuclear Nonproliferation Treaty (NPT).

## **Chapter 3**

### **United States–Ukraine Case Study**

*The U.S. strategic goal is to see Ukraine firmly on the road to a democratic, market-oriented economy, a sovereign nation that is a key political and economic partner of the U.S. and increasingly integrated into European and global economic and security systems.*

—President Bill Clinton.

#### **Introduction**

This chapter uses the Bilateral Arms Control Model to explain strategic arms control between the United States and Ukraine. The model explains how both nations tailored their policies to accommodate evolving objectives, modulated by fog and friction. The model also accounts for negotiations which address both nation's economic and security concerns in the context of strategic arms control. An understanding of how the model depicts previous arms control events between the United States and Ukraine leads to a more structured, long-term development of future arms control policies.

The chapter is organized around the Bilateral Arms Control Model's assessment-decision-action framework from the United States' perspective. First, the authors provide an assessment of Ukrainian strategic will and capability. This assessment, along with publicly stated United States' objectives, permits the extrapolation of specific arms control policies with Ukraine. Next comes an examination of the instruments of power

the United States has to achieve its arms control objectives with Ukraine. On the Ukrainian side, the model explains how Ukraine used its nuclear arsenal to influence the United States and achieve its political objectives. All the while, both nations conducted negotiations resulting in formal arms control agreements to consolidate the fulfillment of their objectives.

## **Why Study Arms Control With Ukraine?**

Arms control between the United States and Ukraine provides an interesting and important real-world example of how nations use the instruments of national power to exert influence and achieve their political objectives. With the breakup of the Soviet Union in 1991, the status of the START I treaty became questionable while Ukraine emerged as a new nuclear nation. Ukraine possessed both intermediate and strategic nuclear weapons without any explicit legal obligation to existing arms control treaties and agreements. Ukraine also enjoyed freedom from the Soviet Union and a strong desire to maintain its independence. For Ukrainian nationalists, the control of nuclear weapons was tantamount to a sovereignty insurance policy against Russian expansionism.<sup>1</sup> However, complete Ukrainian sovereignty was bridled by its heavy economic dependence on Russia, especially for much of its energy needs. Furthermore, the Ukrainian economy faltered in its transition from a centralized-control to a market-based economy. Ukraine's deep economic problems, coupled with regional security concerns, set the stage for the United States to assert its arms control influence.<sup>2</sup> Conversely, the United States desire to encourage Ukrainian democracy, economic stability, and nuclear non-proliferation set the stage for Ukrainian arms control influence with the United States.

Ukraine is also a worthy case study because of its important geopolitical position between Russia and central Europe. The Ukrainian capital, Kiev, once served as one of the great European trade centers—a position it hopes to occupy again. Within the Soviet Union, Ukraine was second only to the Russian Republic in economic importance and produced more than three times the output of the next ranking republic. Furthermore, Ukraine was the Soviet Union's breadbasket which generated more than one-fourth of the entire Soviet agricultural output. In the post-Soviet economy, Ukraine maintains its agricultural leadership as well as its heavy industry, which continues to supply equipment and raw materials to other former Soviet Republics. By way of comparison, Ukraine is roughly the size of France and its economy is approximately one-fourth that of Mexico.<sup>3</sup>

Table 3-1 gives a snapshot of Ukraine and its people.

**Table 3-1. Snapshot of the Ukraine<sup>4</sup>**

<i>Ethnic Makeup</i>		<i>Neighboring Countries</i>	
		<i>Common Border</i>	<i>Km</i>
Ukrainian	(73%)	37.4 million	Russia
Russian	(22%)	11.3 million	Moldova
Belarussians	(1%)	0.5 million	Belarus
Other	(4%)	2.0 million	Poland
<i>Labor Force</i>		<i>Coastline</i>	
Industry and Construction	33%	Romania (west)	362
Agriculture and Forestry	21%	Romania (southwest)	169
Health, Education, and Culture	16%	Hungary	103
Trade and Distribution	7%	Slovakia	90
Transportation and Communication	7%		
Other	16%	Black Sea Coast	2,782

## An Arms Control Dilemma

As mentioned earlier, the breakup of the Soviet Union in August 1991 introduced ambiguity into START I. At the time, an apparent means of resurrecting the treaty was

through the Commonwealth of Independent States, composed of 15 former Soviet Republics. Commonwealth members began with lofty goals—a coordinated economic policy and a united army with joint control over nuclear weapons. However, it soon became clear the 15 Commonwealth governments did not share the same strategic goals. In particular, Ukraine rejected a permanent Commonwealth infrastructure as a prelude to another Russian empire.

Since Russia was internationally recognized as the rightful heir to the Soviet nuclear arsenal, Russia and the United States desired to jointly implement the START I treaty. The major impediment was that three other nations—Ukraine, Kazakhstan, and Belarus— inherited large portions of the Soviet nuclear arsenal. Hence, there was a dilemma about how to bring about the withdrawal of these weapons from the sovereign nations of Ukraine, Kazakhstan, and Belarus. During their transition to independence, the three nations had declared they would become non-nuclear nations; however, after independence, they became ambivalent for two main reasons typified most profoundly by Ukraine. First, Ukraine began to see its inherited nuclear weapons as a means of ensuring its security and sovereignty.<sup>5</sup> Second, Ukraine desired economic aid as well as compensation for the nuclear materials and costs of weapons elimination.<sup>6</sup> Hence, to overcome the arms control dilemma and implement the START I treaty, Ukrainian security and economic issues required further attention.

## **Significant Events in Ukrainian Arms Control**

A brief review of key Ukrainian events will help explain how the Bilateral Arms Control Model applies to the United States and Ukraine. Table 3-3 traces the evolution

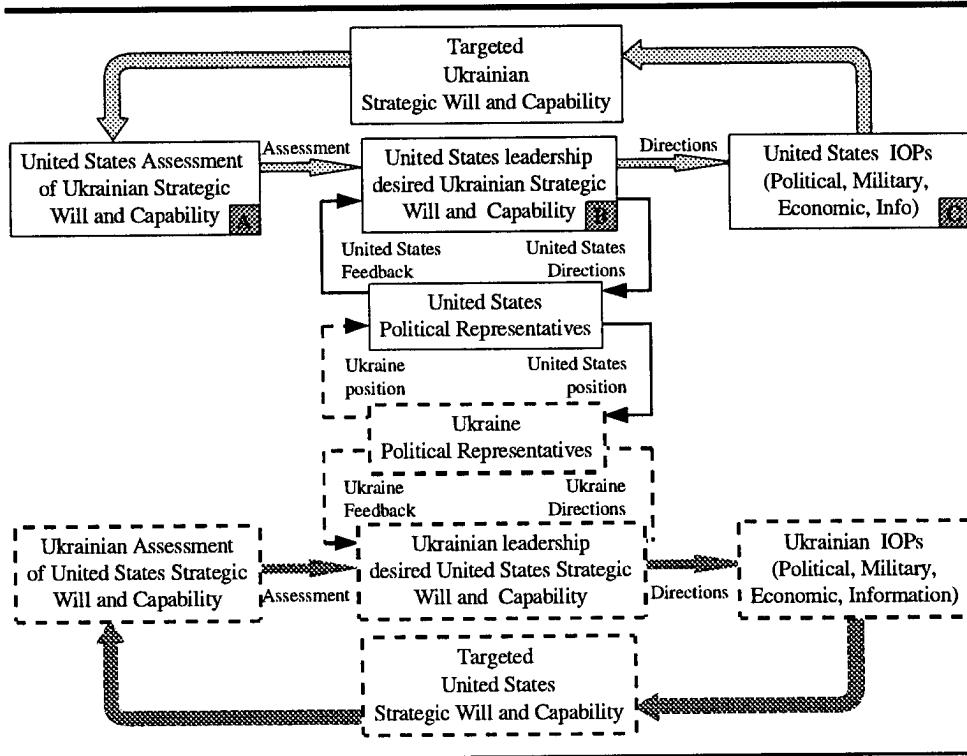
of Ukrainian strategic arms control from its independence in 1990 through the removal of all nuclear weapons scheduled to be complete during 1996. This table highlights how fog and friction waxed and waned throughout events as the United States and Ukraine conducted negotiations concurrent with their respective assessment-decision-action cycles. The Bilateral Arms Control Model will be used to explain the major United States–Ukrainian arms control events of Table 3-3.

Figure 3-1 depicts the Bilateral Arms Control Model with the United States and Ukraine each acting on the will and capability of each other simultaneous to negotiations. With the addition of fog and friction, the model offers a structured framework to explain the significant arms control events of Table 3-3. For example, the breakup of the Soviet Union in August 1991 resulted in an independent Ukraine with an evolving, sometimes conflicting, strategic will and capability. A quick assessment verified Ukraine's uncertainty over giving up its nuclear weapons because of security concerns and as leverage for potential economic aid. The President and the Congress of the United States desired to influence Ukraine (as well as the other former Soviet nations) toward a non-nuclear status. The United States influenced Ukraine through both the commitment of financial support and the reassurance of Ukrainian security under the Nuclear Non-Proliferation Treaty (NPT). In this setting, the political representatives conducted negotiations resulting in Ukrainian acceptance of the START I Lisbon Protocol in May 1992.<sup>7</sup> In this agreement, Ukraine pledged to become a non-nuclear nation. As a “carrot” of influence, Congress initiated the Nunn-Lugar Cooperative Threat Reduction Program to help Ukraine achieve a non-nuclear status. However, friction between the Ukrainian president and parliament resulted in the parliament rejecting Article V of the Lisbon

Protocol; hence, Ukraine retained its nuclear weapons as leverage for economic aid and as a source of security.

**Table 3-3. Evolution of Events in Ukrainian Arms Control**

Date	Event
31 Jul 91	President Bush and President Gorbachev sign START I
Aug 91	Soviet Union dissolves: START I validity is questionable
24 Aug 91	Ukraine declares independence from Soviet Union
Nov 91	Congress initiates Nunn-Lugar Cooperative Threat Reduction Act
8 Dec 91	Formation of the Confederation of Independent States
6 May 92	Ukrainian tactical nukes removed to Russia
23 May 92	Lisbon Protocol Agreement: Leaders of United States, Russia, Ukraine, Belarus, and Kazakhstan agree to implement START I; latter three agree to become non-nuclear nations
May 92	Ukraine completes the transfer of all tactical nuclear missiles to Russia
18 Nov 93	Ukrainian parliament rejects Article V of the Lisbon Protocol <sup>8</sup> (under Article V, Ukraine agrees to become a non-nuclear nation)
14 Jan 94	Trilateral Agreement: United States and Russia give Ukraine security assurances and promise compensation for nuclear material in forfeited Ukrainian weapons
3 Feb 94	Ukrainian parliament ratifies START I with the provision that Ukraine remains a nuclear nation (i.e., Ukraine reduces its nuclear arsenal)
8 Feb 94	Ukraine joins the North Atlantic Treaty Organization's Partnership for Peace program
Feb 94	Ukraine begins shipping nuclear warheads to Russia (approximately 27 shipments of 60 warheads each)
10 Jul 94	Ukraine elects President Kuchma
Aug 94	Nunn-Lugar Cooperative Threat Reduction funding begins in Ukraine: \$273 million through Jan 96
16 Nov 94	Ukrainian parliament accepts Non-Proliferation Treaty, conforming to Article V of the Lisbon Protocol (vote tally: 301 to 8)
Nov 94	President Kuchma has first summit in United States and receives treatment equivalent to a "Russian President"
5 Dec 94	Presidents Clinton, Yeltsin, and Kuchma deposit NPT Instruments and START I enters into force between the United States and Russia
96	Year in which all nuclear warheads scheduled to be out of Ukraine



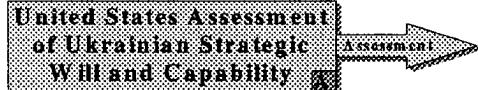
**Figure 3-1. The United States–Ukrainian Bilateral Arms Control Model**

The Trilateral Agreement—between the United States, Russia, and Ukraine—resulted primarily from Ukrainian parliamentary influence (i.e., rejection of Article V of the Lisbon Protocol). At the same time the United States sought to influence Ukraine, Ukraine sought to influence the United States. A rough Ukrainian assessment of the United States revealed an ability (albeit not necessarily the will) to provide security guarantees, as well as substantial economic aid. Hence, Ukrainian representatives targeted these aspects in negotiations. Following the parliament's rejection of Article V of the Lisbon Protocol, Ukraine had significant bargaining power in terms of its nuclear weapons. The resulting Trilateral Agreement awarded Ukraine security assurances as well as economic aid in return for Ukraine's commitment to become non-nuclear.<sup>9</sup> This

overview can be broken into more detail using the framework of the Bilateral Arms Control Model beginning with an assessment by the United States.

### **United States Assessment: Ukrainian Strategic Will and Capability**

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**Figure 3-2. United States Assessment in the Bilateral Arms Control Model<sup>10</sup>**

Using the Bilateral Arms Control Model to treat Ukraine as a system (by assessing its strategic will and capability) provides an understanding of how the United States tailored its arms control policy with Ukraine. Of will and capability, Ukrainian nuclear capability is most directly measurable and, so, is discussed first. Table 3-4 depicts the formidable nuclear arsenal Ukraine inherited upon its independence—the world’s third largest. In particular, Ukraine retained<sup>11</sup> 130 SS-19 Inter-Continental Ballistic Missiles (ICBMs) with up to 6 warheads each; 46 SS-24 ICBMs with up to 10 warheads each; and 21 strategic bombers (i.e., “Bears” and “Blackjacks”) with approximately 416 air launched cruise missiles.<sup>12</sup> Although Ukraine has no weapons design or production facilities, these deficiencies are not insurmountable since Ukraine also has several dozen nuclear weapons scientists and engineers, as well as two ICBM production facilities (i.e., SS-18 and SS-24).<sup>13</sup>

**Table 3-4. 1994 Ukrainian Nuclear Capability<sup>14</sup>**

	US	Russia <sup>15</sup>	Ukraine <sup>16</sup>	China	Britain	France
ICBM Warheads	2055	3574	1240	110	0	18
Bomber Weapons	2650	984	416	150	100	80
SLBM Warheads	2880	2350	0	24	196	384
<b>Total Strategic Weapons</b>	<b>7585</b>	<b>6908</b>	<b>592</b>	<b>284</b>	<b>296</b>	<b>482</b>

In contrast to capability, the strategic will of the Ukrainian leadership was measurable only indirectly through both open and covert sources. For this discussion, Ukrainian will has been derived from open published sources. These sources point to the fact that Ukrainian strategic will was shaped by its desires to both maintain its sovereignty and improve its economy. The strong will of the Ukrainian nationalists to maintain nuclear weapons for their security and territorial integrity certainly matched their nuclear capability documented above. Table 3-5 summarizes the principal components of Ukrainian nuclear will: strategic beliefs, enhanced security, increased prestige, and negotiating leverage.

**Table 3-5. Ukrainian Strategic Will<sup>17</sup>**

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*Strategic Belief*

- Mistrust of Russian intentions; Russian dominance since 17th century
- Desire for trade and economic well-being

*Security*

- Ensure Ukrainian sovereignty
- Maintain territorial integrity

*Prestige*

- Establish formal links with the United States
- Cast an international presence
- Membership in the “nuclear club”
- Prominence in East Europe

*Leverage*

- To negotiate security assurances
- To develop alliances to help stop a potential expansionist Russia
- To obtain United States assistance and international aid
- To have “someone else” pay to eliminate the nuclear weapons and infrastructure

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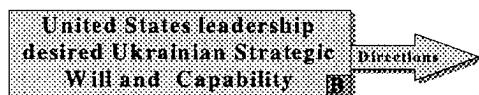
Without doubt the Russo-Ukrainian relations color virtually every aspect of Ukrainian strategic will. Specifically, historic enmity between Ukraine and Russia has reinforced Ukraine’s insecurity and created a drive for greater independence. However, complete independence is constrained by Ukraine’s economic dependence on Russian oil and natural gas for which it owes a cumulative debt of \$2.5 billion.<sup>18</sup> The Bilateral Arms Control Model also requires an analysis of the various factors, including friction with Russia, which have shaped Ukrainian will.

Clearly, the relationship between Russia and Ukraine weighs heavily on the assessment of Ukrainian strategic will. The 300-year Russian domination over Ukraine (i.e., “Little Russia”) has caused significant friction between the two nations. This is

of Ukraine requires continual reassessment to try to keep abreast of the varying Ukrainian strategic will. Each assessment of Ukraine is followed in the Bilateral Arms Control Model by the need for decisions.

### **United States Decisions: Arms Control Policy Formulation**

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**Figure 3-3. United States Policy Formulation in the Bilateral Arms Control Model<sup>20</sup>**

An assessment of Ukrainian will and capability enabled the United States to tailor specific policies for Ukraine in order to address their security concerns and economic problems. In doing so, the United States ensured its policies were congruent with its overarching national objectives of (1) enhancing United States security, (2) promoting United States prosperity, and (3) promoting democracy abroad. Table 3-6 lists these objectives along with the corresponding arms control strategic objectives.

**Table 3-6. United States National and Strategic Objectives for Arms Control<sup>21</sup>**

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*National*

- Enhance United States security
- Promote prosperity at home
- Promote democracy

*Strategic*

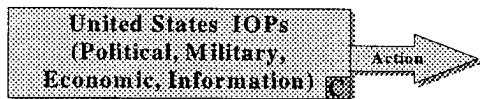
- Implement existing strategic arms control agreements
- Prevent the spread of weapons of mass destruction and the means to deliver them
- Institute strict controls and constraints on fissile materials
- Tailor global proliferation strategies to specific regional contexts
- Encourage regional arms control agreements
- Advance the rule of international law and promote cooperation among participants

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The breakup of the Soviet Union injected uncertainty into START I. As a result, all of the United States' strategic arms control objectives remained unfulfilled with Ukraine. Arms control negotiators immediately began trying to reach an agreement to legitimize START I. Concurrently, United States decision makers, namely the President and Congress, directed general actions through the economic, military, and diplomatic instruments of power. This is discussed as the next step in the Bilateral Arms Control Model.

## **United States Action: Arms Control Policy Implementation**

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**Figure 3-4. United States Actions in the Bilateral Arms Control Model<sup>22</sup>**

Considering the previous assessment of Ukraine and in line with the United States' national objectives, United States leadership directed action to control the proliferation and subsequent elimination of Ukrainian nuclear weapons. These actions correlate with the corresponding action step in the Bilateral Arms Control Model. In particular, Congress specifically created the Nunn-Lugar Cooperative Threat Reduction program directed toward the former Soviet republics to ensure nuclear stability and control nuclear proliferation. Congress created the Cooperative Threat Reduction Program to achieve the noteworthy objectives listed in Table 3-7. This program is particularly remarkable in terms of addressing not only nuclear warheads and delivery vehicles, but all weapons of mass destruction along with the supporting infrastructure. As an example, the Cooperative Threat Reduction Program helped create the Science and Technology Center of Ukraine “to give Ukraine’s strategic-weapons scientists and engineers opportunities to redirect their talents to peaceful activities.”<sup>23</sup> Hence, Ukrainian nuclear scientists and engineers were “targeted” as well. In addition, the Cooperative Threat Reduction Program funded several Ukrainian housing construction projects for demobilized Strategic Rocket Forces officers; otherwise, silo elimination could not proceed. For

example, The Department of Defense constructed a \$16 million apartment complex in Khmelnitsky, Ukraine.<sup>24</sup>

**Table 3-7. Cooperative Threat Reduction Objectives<sup>25</sup>**

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- Destroy nuclear, chemical, and other weapons of mass destruction;
- Transport, store, disable, and safeguard weapons in connection with their destruction;
- Establish verifiable safeguards against proliferation of such weapons;
- Prevent diversion of weapons-related expertise;
- Facilitate demilitarization of defense industries and conversion of military capabilities and technologies; and
- Expand defense and military contracts between the United States and the new independent states

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As part of an effort to stabilize Ukraine and foster democracy, the United States' leadership directed economic action to engage Ukraine. The United States invested in Ukraine after the Cold War similar to investments made within Europe and Japan following World War II. In particular, the United States has invested approximately \$1 billion in Ukraine since 1991 (including \$272 million in Cooperative Threat Reduction funds<sup>26</sup>).<sup>27</sup> By promoting Ukrainian democracy and economic stability, the United States sowed seeds for its future prosperity especially in terms of trade. Indeed, a stable, democratic Ukraine opens new economic markets for the United States. In sum, the net effects of United States actions have not only been seen in the Ukrainian nuclear capability, they have also been felt in the Ukrainian nuclear will. This is most clearly seen in the realm of negotiations.

## **Negotiations Between the United States and Ukraine**

The Lisbon Protocol of May 1992 was the first agreement which sought to apply the START I treaty to the former Soviet nations. After ratification of the Lisbon Protocol, the leaders of Ukraine, Belarus, and Kazakhstan undertook to eliminate all the strategic nuclear weapons on their territory and to accede to the NPT as non-nuclear weapon states. Whereas Belarus and Kazakhstan soon ratified the Protocol, the Ukrainian parliament postponed ratification by their initial rejection of Article V. The question of Ukrainian nuclear status became a controversial issue in Russo-Ukrainian relations, as well as in Ukraine's relations with the West. The Ukrainian Government desired to be compensated Ukraine for the cost of disposing of the weapons. The Ukrainian Government also demanded security guarantees from Russia and the West, against both nuclear and conventional attack, particularly from Russia.

The Ukrainian Government believed that United States policy was short-sighted, relegating Ukraine to a subsidiary position which neglected its new geopolitical position in Europe. It was true that both bilateral and multilateral aid was directed primarily to Russia and this reflected the United States focus on Russia at the expense of the other Soviet-successor states. With regard to Ukraine's security concerns, the United States believed sufficient security guarantees were implicit in the terms of the NPT. In addition North Atlantic Cooperation Council extended membership to the former Soviet states in order to allay their security concerns. The 1994 Partnership for Peace program was another measure to enhance Ukrainian security. The successor states also became members of the United Nations and of the Conference on Security and Cooperation in

Europe. What the United States would not do was to offer Ukraine explicit guarantees against future Russian expansionism, which was at the heart of Ukrainian fears.

### **Summary of Fog and Friction in United States–Ukrainian Arms Control**

As discussed in the preceding analysis, fog and friction entered United States–Ukrainian arms control process several ways. Foremost among these was the United States initial uncertainty over Ukrainian strategic objectives. In particular, the United States had difficulty understanding Ukrainian strategic motivations (i.e., nuclear will) of the elected leadership in the midst of nationalist opposition rhetoric.<sup>28</sup> This was compounded by Ukrainian uncertainty over its security and fears of Russian hegemony. The United States also seemed slow to recognize the potential bargaining leverage of Ukraine’s nuclear arsenal.<sup>29</sup> Ukraine eventually parlayed its nuclear arsenal into security assurances and assistance for nation building.<sup>30</sup>

The United States also encountered fog when measuring Ukraine’s nuclear capabilities. Questions remain shrouded in fog as to the status of strategic proliferation from Ukraine. In the chaotic aftermath of the Soviet dissolution, Ukraine has progressed slowly in implementing viable nuclear export controls.<sup>31</sup> Ukraine has had to balance its economic problems with immediate security concerns and the United States’ nonproliferation objectives. Recall that the United States’ Cooperative Threat Reduction program is a major economic effort to control the proliferation of Ukrainian personnel, material, and technology. Continual assessments must deal with the possibility of Ukrainian nuclear proliferation, especially in terms of personnel and missile technology.

The main source of friction in the arms control process appeared between Ukrainian parliament and president. The Ukrainian Parliament did not initially ratify the Lisbon Protocol signed by the Ukrainian president due to nationalist sentiment in parliament. Ukrainian nationalists viewed their nuclear arsenal as a means to keep Russia at bay. Fortunately for Ukraine, this act of friction (i.e., competing decision makers) increased the bargaining leverage enjoyed by Ukraine.

### **The Next Assessment-Decision-Action Cycle with Ukraine**

Although it is not possible to accurately predict the future relationship with Ukraine, it is possible to make some general statements about the United States' future assessment-decision-action cycles with Ukraine. First, the United States will continue to promote regional stability in Ukraine through additional economic incentives, even after Ukraine has no remaining nuclear weapons.<sup>32</sup> Ukraine certainly can produce ICBMs and has the nuclear expertise to develop nuclear warheads. Hence, the United States will attempt to stabilize Ukraine's economy as a means to stabilize Ukrainian nuclear will, contain nuclear proliferation, and ultimately enhance the United States' prosperity through future trade. Second, the United States will continue to reassure Ukraine of its security pledge through such means as Partnership for Peace exercises. Ukraine does indeed occupy a strategic geopolitical position; the United States does not overlook this fact in any assessment. Finally, the United States will continue to use arms control as a vehicle to promote and stabilize the new Ukrainian democracy. The massive billion dollar outlay in funds certainly entices Ukraine to embrace political, as well as economic, reform. The

engagement of Ukraine will ultimately enlarge the number of American allies and democracies.

## Summary

This chapter used the Bilateral Arms Control Model as a framework to explain significant arms control events between the United States and Ukraine (from the United States' perspective). The model addressed the United States' assessment, decision, and action steps taken within its feedback cycle to try to achieve its strategic objectives with Ukraine. The model also explained the negotiations which took place between the United States and Ukraine. The friction induced by the Ukrainian parliament (albeit unintentional) proved useful as a means to negotiate additional United States security assurances in the Trilateral Agreement. Predicting the next feedback cycle with Ukraine, the United States will continue to use arms control as a means of achieving stability and promoting democracy in Ukraine.

## Notes

<sup>1</sup> C. J. Dick, (1993). "The Military Doctrine of Ukraine." 35 paragraphs. Available GOPHER: gopher://gopher.nato.int/00/secdef/csrc/OCC/occbrf27.txt [1996, January 16]: 19–23.

<sup>2</sup> Federal News Service. "Remarks by Secretary of Defense William Perry at a Conference Sponsored by the National Defense University's College of the Armed Forces, The Defense Department and the Commerce Department," 10 pages, (Baruch Auditorium, Washington, D.C., April 19, 1995), 10.

<sup>3</sup> Central Intelligence Agency, *The World Factbook 1995*, (Washington D.C.: Office of Public and Agency Information, 1995), 144, 280–281.

<sup>4</sup> Ibid., 435.

<sup>5</sup> Royal Services Institute for Defense Services Newsbrief, "A Nuclear Ukraine?," February, 1993, v. 13, no. 12, 13–14.

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<sup>6</sup> Alexander Goncharenko, *Ukrainian-Russian Relations: An Unequal Partnership*, (London: Royal United Service Institute for Defense Studies, 1995) 63.

<sup>7</sup> United States Arms Control and Disarmament Agency, “Protocol to the Treaty Between the United States of America and The Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms,” (Washington, D.C.: Office of Public Information, January 1995), 1–6.

<sup>8</sup> Strategic Arms Reduction Treaty, Protocol to the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms; Article V states “The Republic of Belarus, the Republic of Kazakhstan, and Ukraine shall adhere to the Treaty on the Non-Proliferation of Nuclear Weapons of July, 1968 as non-nuclear weapon states Parties in the shortest possible time, and shall begin immediately to take all necessary action to this end in accordance with their constitutional practices.”

<sup>9</sup> United States Arms Control and Disarmament Agency, “Trilateral Statement by the Presidents of the United States, Russia and Ukraine,” (Washington, D.C.: Office of Public Information, 1994), 1–4. The Trilateral Statement signed by the Presidents of the United States, Russia, and Ukraine states: “Presidents Clinton and Yeltsin informed President Kravchuk that the United States and Russia are prepared to provide security assurances to Ukraine. In particular, once the START I Treaty enters into force and Ukraine becomes a non-nuclear weapon state party to the NPT, the United States and Russia will reaffirm their commitment to Ukraine in accordance with the principles of the Conference on Security and Cooperation in Europe (CSCE) Final Act, to respect the independence and sovereignty and the existing borders of the CSCE Member States and recognize that border changes can be made only by peaceful and consensual means; and reaffirm their obligation to refrain from the threat or use of force against the territorial integrity or political independence of any state, and that none of their weapons will ever be used except in self-defense or otherwise in accordance with the charter of the United Nations;”

<sup>10</sup> This figure corresponds to block “A” in Figure 3-1.

<sup>11</sup> Russia actually controls the command system and launch codes.

<sup>12</sup> J. F. Dunn, J. F. (1993). “The Ukrainian Nuclear Weapons Debate.” 41 paragraphs. Available GOPHER: <gopher://gopher.nato.int/00/secdef/csrc/OCC/occbrf18.jfd> [1996, January 16]: 13.

<sup>13</sup> Steven Woehrel. “Ukraine.” Congressional Research Service Issue Brief. Document No. IB92072, February 1995, 13.

<sup>14</sup> Stimson Center (1995), “Operational Strategic Stockpiles of the Five Declared Nuclear Powers.” 1 page. Available HTTP: <http://www.stimson.org/pub/stimson/zeronuke/stock.htm> [1996, January 16]: 1.

<sup>15</sup> Includes Kazakhstan (4th largest arsenal) and Belarus (eighth largest arsenal); See Carey Sublette, (1996). “Nuclear Weapons Frequently Asked Questions.,” Version 2.11,

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14 sections. Available HTTP: <http://www.onestep.com:80/milnet/nukeweap/nfaq0.html> [1996, March]: 7.

<sup>16</sup> Serhiy Tolstov, "International Factors of Nuclear Disarmament of Ukraine," Spring 94 Ukrainian Review, 5–6.

<sup>17</sup> This table reflects the authors' formulation of Ukrainian strategic will based on research contained in the bibliography.

<sup>18</sup> This figure pertained up through mid-1995. See Eugene B. Rumer, "Russian-Ukrainian Relations: Hitting New Lows," Rand Project Memorandum, PM-427-OSD, June 1995, 3–4.

<sup>19</sup> Woehrel, "Ukraine," 10–11. The entire Black Sea Fleet consists of 350 surface ships and 20 attack submarines; this constitutes one-fourth of the Soviet Fleet.

<sup>20</sup> This figure corresponds to block "B" in Figure 3-1.

<sup>21</sup> White House, *A National Security Strategy of Engagement and Enlargement*. (Washington, D.C.: US Government Printing Office, 1995) I, 13–15. This table is a summary of the objectives presented in the work referenced.

<sup>22</sup> This figure corresponds to block "C" in Figure 3-1.

<sup>23</sup> Ted Speers (1995). "Science and Technology Center of Ukraine." Available HTTP: <http://www.cam.org/~ukugmtl/stcu95j.html> [April 14, 1996]: 30 sections.

<sup>24</sup> Office of the Secretary of Defense News Release, "Nunn-Lugar Joint Venture Project Launched," Reference Number: No. 969-94, 1.

<sup>25</sup> Department of Defense, "Cooperative Threat Reduction." 9 sections. Available HTTP: <http://www.dtic.dla.mil/defenselink/special/ctr/index.html>, 1–3.

<sup>26</sup> Olya Oliker, "Cooperative Threat Reduction Assistance to Ukraine," (Washington, D.C.: Office of the Secretary of Defense, January, 1996), 1.

<sup>27</sup> White House, Office of the Press Secretary. "U.S. Bilateral Economic Assistance to Ukraine," May 1995, 1.

<sup>28</sup> Sherman W. Garnett, "Ukraine's Decision to Join the NPT," *Arms Control Today*, (January/February 1995): 9.

<sup>29</sup> *Ibid.*, 11.

<sup>30</sup> Roman Solchanyk and John E. Tedstrom. "Ukraine: Political-Economic Trends and Prospects for Stability," RAND Project Memorandum, PM-387-OSD. February 1995, 19.

<sup>31</sup> Sarah Jacobson (1995). "A Comparison of Russian and Ukrainian Export Control Regimes." Available HTTP: <http://infomanage.com/nonproliferation/najournal/fsuexportcontrols.html> [January 16, 1996]: 15 pages, 1.

<sup>32</sup> Eric R. Terzuolo, "Prospects for Ukraine: An American View," *The Atlantic Council of the United States Bulletin*, Vol. VI, No. 2 (February 1995): 1.

## **Chapter 4**

### **Summary and Topics for Future Study**

*The main purpose of arms control is to enhance national security. Although it may be viewed as a diplomatic mission, the military can play a vital role.*

—Joint Pub 3-0, Doctrine for Joint Operations

### **Summary**

This paper developed an original arms control model labeled the Bilateral Arms Control Model. The model is based on parallel feedback cycles in which nations assess opponents as a system to be influenced through national instruments of power. In the model, the political feedback cycle of each nation begins with an assessment of the strategic will and capability of the opposing country. By considering ongoing assessments, the national leaders decide if they should take action. If so, the leaders direct their staffs to use diplomatic negotiations and employ their instruments of power to influence the will and capability of the opposing country. A nation targets specific instruments of power at precise, planned components of the opposing nation's strategic will and capability in order to influence the country to control their strategic arms by agreement. Continual assessments analyze the effects of the actions taken and the political feedback cycle continues in concert with the negotiation process.

An important feature of the model is its dichotomy of the two competing nations where one is the controller and the other is the system. This separation allows the clear understanding of how fog and friction enter the arms control process. In particular, fog consists of factors which intervene between the controller and system nations. Fog hinders the controller nation's targeting of the system nation. In addition, fog obscures the controller nation's measurements of the system nation. In contrast, friction consists of factors internal to a nation. Friction, such as competing decision makers, impedes national assessment, decisions, and/or actions.

The model emphasizes measuring both strategic will and capability since both of these reveal objective fulfillment as well as possible future threats. Nuclear capability is a function of a nation's engineering skills, fissile materials, nuclear facilities, and strategic weapons. In addition, nuclear will is a function of strategic influence, regional security, international prestige, and bargaining leverage. Strategic will and capability are closely linked in that arms control strategies generally influence strategic will in order to measure nuclear capability.

Effective measures of arms control are those which pierce measurement fog in order to assess how well objectives are met. Robust assessments use intelligence gathered from a multiplicity of sources including national technical means, on-site inspections, and human intelligence. Moreover, robust measures of effectiveness seek to monitor nuclear will in addition to nuclear capability. This approach avoids the danger in focusing too narrowly on accessible technical measures of arms control which may not accurately reflect objective fulfillment.

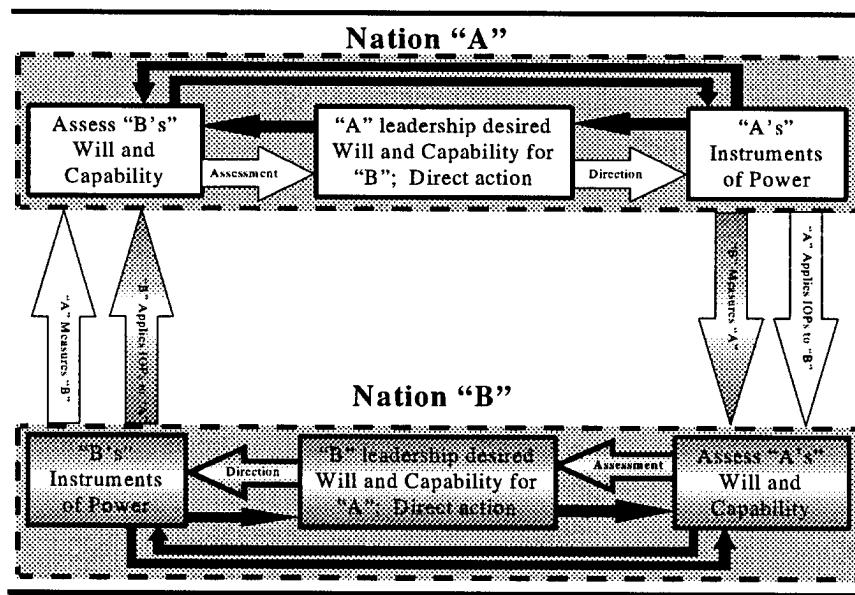
This research highlighted how a nation needs to accomplish four broad tasks to reach a successful arms control agreement: (1) define the opponent country as a system and determine its strategic will and capability, (2) formulate specific, attainable strategic arms control objectives, (3) cultivate the internal will and develop national instruments of power to achieve those strategic objectives, and (4) use the instruments of power to influence specific aspects of the opponent country. In the end, both nations must agree to control their strategic arms for lasting success.

Even though the model was explained using the United States and Ukraine, the Bilateral Arms Control Model applies to a broad range of arms control scenarios. The authors chose Ukraine due to its geopolitical importance and its recent arms control events. In particular, the United States sought to ensure that the Ukrainian nuclear arsenal remained tightly controlled and subsequently eliminated according to the START I treaty and Lisbon Protocol. The underground market for nuclear weapons, their key components, and people with nuclear expertise are in great demand by groups and nation states with sinister motives—an aggressive strategic arms control policy reduces this security threat to the United States. Hence, arms control continues to serve the security interests of the United States by actively influencing other nations to counter nuclear proliferation and control their strategic arms.

## **Topics for Future Study**

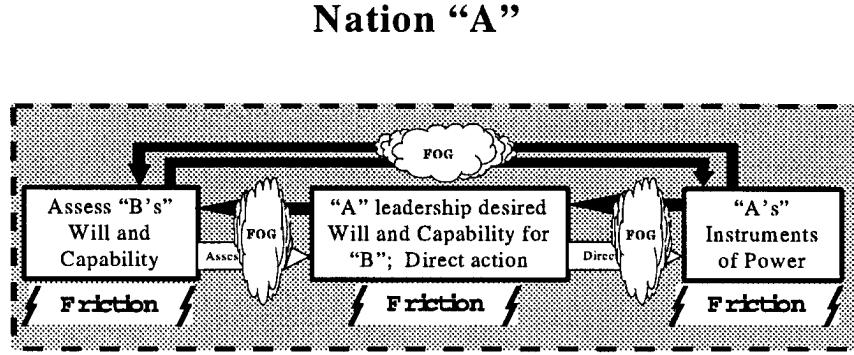
The model developed in this paper has wide-ranging applications for future study. The simplicity of the model captures the essential bilateral dynamics between two nations or two groups of nations. Additional research can explore alternative variations of the

model. A preliminary version of the arms control model considered the placement of both the controller and system nations within the same feedback loop as shown in Figure 4-1. Because this model de-emphasized the arms control negotiation process, it was dropped from further analysis in the present work. However, in the context of related “control” research, this model could be used to analyze the targeting of opponent nation’s assessment-decision-action cycle. In particular, targeting in this model would point to creating or reducing fog and friction as part of the influence process. In addition, this model emphasizes the need to minimize fog and friction in one’s own assessment-decision-action cycle.<sup>1</sup>



**Figure 4-1. Controller and System Nations in Side-by-Side Feedback Loops**

Alternatively, if negotiations remain an important part the research application, the system nation of the Bilateral Arms Control Model can also be expressed in terms of its assessment-decision-action cycle rather than in terms of its strategic will and capability. Additional research could use the fog and friction model of Figure 4-2 as a starting point to gain insight into such an approach.

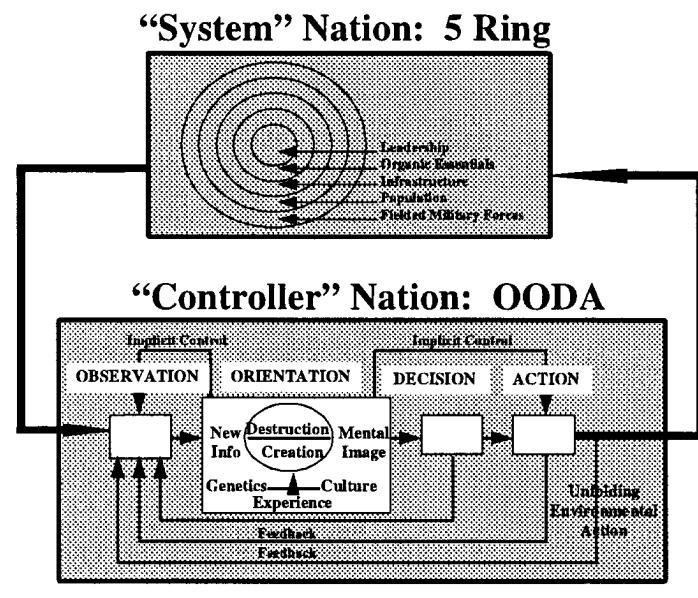


**Figure 4-2. Fog and Friction Within Nation “A”**

This analysis could examine how to influence the internal communication and control channels which have been explicitly shown as the blackened lines in Figure 4-1. For instance, the model suggests the well-known fact that opponent friction is increased by targeting a nation’s communication links.

The Bilateral Arms Control Model developed in this work also lays the groundwork for an enlarged study of control warfare in which command and control systems are targeted to achieve strategic paralysis. In this vein, the model presented herein easily facilitates the merger of Warden’s five-ring system<sup>2</sup> analysis with Boyd’s observation-orientation-decision-action (OODA) loop.<sup>3</sup> Previously, this topic has been a subject of intense research.<sup>4</sup> Specifically, the targeted nation need not be analyzed as a system composed of strategic will and capability; Warden’s five-ring analysis is also suited for this task. In particular, Warden’s five-ring analysis examines the target nation in terms of its leadership, system essentials, infrastructure, population, and fielded forces. Additionally, the controlling nation need not be separated in the assessment-decision-

action cycle; Boyd's observation-orientation-decision-action loop is also capable of explaining certain controlling aspects of a nation, albeit in a more limited fashion.<sup>5</sup> Previous research with the OODA loop limited the focus to speeding up one's own operations in order to operate at a faster tempo (i.e., quicker OODA loop) than the adversary. Although Boyd's OODA loop has not previously explained the controlling aspects of the OODA loop, the feedback principles set forth in the present work fill this gap.



**Figure 4-3. Merger of Boyd's OODA Loop With Warden's 5-Ring Model**

Although the Bilateral Arms Control Model was developed to address arms control at the national and strategic levels, it can also address the tactical and operational levels of arms control. Indeed, the feedback model can be viewed as a fractal in that it possesses self similarity at different levels.<sup>6</sup> For instance, whereas Figure 2-2 depicted fog and friction between the controller and system, Figure 4-2 depicted fog and friction

between the individual components within the same system. Hence, follow-on work could explore similar arms control analysis at the tactical and operational levels.

The many avenues suggested for additional research confirm the profound utility of the Bilateral Arms Control Model. Indeed, the model affords a pioneering perspective not only into the strategic arms control process, but other control processes as well. It is anticipated that further work will produce rich rewards based on the efforts of the present work.

## **Conclusion**

The Bilateral Arms Control Model developed in this work captures the essential dynamics of the strategic arms control process. Nations use their instruments of power in concert with negotiations to achieve their arms control objectives. The model accurately points to the fact that nations first assess their opponent's strategic will and capability in order to tailor their approach to the specific arms control problem. During much of the Cold War, the Soviet Union constituted the primary arms control problem; however, the Soviet dissolution required a wider focus with other nuclear nations on a case-by-case basis. The framework of the Bilateral Arms Control Model provides a comprehensive framework to examine these post-Cold War arms control cases.

To enhance its security, the United States continually assesses arms control threats reflected in other nation's will and capability. In response to these assessments, the United States leadership directs action through chosen instruments of power to achieve the desired state (i.e., nuclear will and capability) in the opposing nation. Varying degrees of fog and friction affect the process; however, these can be minimized through

increased awareness and understanding offered by the arms control model of this work. Furthermore, the model suggests anticipatory, forward-looking assessments by the United States based on measures of effectiveness which indicate future as well as current threats. Such assessments address current threats as well as those anticipated from future adversaries. The primary arms control threat in the future is the proliferation of nuclear capabilities to nations or groups with a hostile nuclear will. The United States arms control actions serve the security interests of the United States by reducing anticipated future threats.

The Bilateral Arms Control Model breaks much new ground by offering a structured vision of the arms control process. The model captures the framework of arms control in the negotiation process as well as in the political feedback process. The causes of fog and friction in arms control then become more apparent and manageable. In the final analysis, arms control will continue to serve its overriding security purpose by influencing the strategic will and capabilities of opposing nations. To this end, the Bilateral Arms Control Model is dedicated.

## Notes

<sup>1</sup> Fog and friction at the organizational and bureaucratic levels can accommodate Graham Allison's organizational and bureaucratic models. See Graham T. Allison, *Essence of Decision* (Boston: Harper Collins Publishers, 1971).

<sup>2</sup> Colonel J. A. Warden, III. "The Enemy As a System." In Yuna Braswell, ed. *Strategic Structures AY96 Coursebook, Volume Two*. (Air Command and Staff College, Maxwell AFB, Ala., 1996), 437–442.

<sup>3</sup> The merger of the work of Warden and Boyd was not considered earlier in this research for two reasons. First, the Bilateral Arms Control Model was developed from feedback principles outside the work of Warden and Boyd. Second, the merger of these two works is not well suited to arms control; rather, this merger is suited to control

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warfare. This merger is worthy of mention here because the development of the Bilateral Arms Control Model has properly set the stage for further research in control warfare.

<sup>4</sup> For references, see Fadok, David S., Fadok, David S., *John Boyd and John Warden Air Power's Quest for Strategic Paralysis*, (Maxwell AFB, Ala.: Air University Press, 1995).

<sup>5</sup> The OODA loop has not previously been shown to act on a system; rather, it has looped back on itself. Figure 4-3 is a momentous embellishment of Boyd's model in that it depicts an "outer loop" acting on a "system" nation. The Bilateral Arms Control Model offered in the present work fully justifies this significant addition. Furthermore, the Bilateral Arms Control Model successfully conveys the basic control mechanisms and feedback principles necessary for additional control research such as that suggested here.

<sup>6</sup> James Gleick. *Chaos: Making a New Science*. (New York: Penguin Books, 1987): 98–103.

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